AN AFFORDABLE ADVANCED SPACE VLBI MISSION

J. S. Ulvestad, J. G. Smith, D. L. Meier, D. W. Murphy, R. A. Preston
Jet Propulsion Laboratory
California Institute of Technology
Mail Code 264-664
Pasadena, CA 91109

We propose a high-sensitivity Space VLBI mission as a successor to the VSOP and Radioastron missions that will be flown in the late 1990s. This future mission has science goals similar to those of the International VLBI Satellite (IVS) that was proposed in the late 1960s. It will take advantage of significant technology advances in the last five years to enable a mission with a total cost expected to be less than $500 million.

The most important attribute of the proposed mission will be a greatly enhanced sensitivity. interferometer baselines to the same ground radio telescopes as those used by VSOP and Radioastron will produce a factor-o of-50 sensitivity enhancement over those missions at frequencies of 1.6, 5, and 22 GHz, with coverage of the 43-GHz band also likely. The highly sensitive centimeter-wavelength mission is preferred over one operating at much shorter wavelengths because of the much greater expense of constructing a space radio telescope (and co-observing ground telescopes) with sufficient sensitivity at frequencies of 86 GHz and higher. The high sensitivity would be achieved by (1) orbiting a telescope in the 30-m class, compared to the 8-10-m antennas of VSOP and Radioastron; (2) making use of a data rate of 1-2 Gigabit/s instead of the 128-Megabit/s rate for the 1990s missions: and (3) flying cryogenically cooled receivers providing total system temperatures of 10-20 K, compared to values of 70-200 K for VSOP and Radioastron. The technologies necessary for these improvements arc available now, or will be in the very near future. Antenna technology is described in the paper by R. Freeland in this session, and the data-recording and correlation capability will exist in the Mark **IV** VLBI system that has been developed by the Haystack Observatory with some contributions from the European VLBI Network. Some technology development work still is necessary for the required long-lived, space-qualified, cryogenic cooling systems.

The root-mean-square noise on baselines between the spacecraft and a 25-m ground telescope will be less than 1 mJy, and will be 0.2- 0.3 mJy for ground telescopes in the 100-m class. Such noise levels will allow mapping of the centimeter-wavelength radio emission (including polarization) of active galactic nuclei at a resolution of 0.1 milliarcsecond with extremely high sensitivity y and dynamic range. Observations of the cores of nearby, low-brightness-temperature extragalactic sources such as Seyfert galaxies will be possible on scales at or below the sizes of their accretion disks. A number of extragalactic water masers will be accessible, with determination of statistical parallaxes of those objects leading to an improved value for Hubble's constant. The low noise levels also will enable observations of radio stars in both their flaring and quiescent states,